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**Date deposited:** 3<sup>rd</sup> March 2011

**Version of file:** Author final

**Peer Review Status:** Peer reviewed

## Citation for item:

Marinov M, Mortimer P, Zunder T, Islam D. [Short Haul Rail Freight Services](#). *RELIT - Revista de Literatura dos Transportes* 2011, 5(1), 136-153.

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**Diretório de Pesquisas****Serviços de Carga Ferroviária de Curta Distância**Marin Marinov 1<sup>†</sup>Philip Mortimer 2<sup>‡</sup>Tom Zunder 3<sup>§</sup>

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**Resumo**

Este artigo pretende demonstrar que os serviços de carga ferroviária de curta distância são exequíveis e apresentam oportunidades de mercado, que têm vindo a ser tradicionalmente menosprezadas. Através de uma análise prática e da investigação de um caso de estudo mostrando a realidade no Reino Unido foi possível concluir que podem haver grandes benefícios quer para as companhias de carga quer para operadores e possuidores de circulações ferroviárias se optarem por prestar serviços de curta distância, serviços rápidos ou de curto prazo e dedicados a certos tipos de mercadorias localizadas. O artigo também aborda de forma breve diferentes modelos de suporte às decisões de gestão relacionadas com o

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transporte de carga ferroviária, alertando para a necessidade e importância de novos modelos e metodologias que auxiliem a eficiência operacional. Por fim, são tiradas conclusões e são apontadas linhas de investigação futuras neste importante tipo de transporte.

**Palavras-chave:** Carga Ferroviária<sup>1</sup>, Serviços de curta distância 2, Modelos 3, Análise prática 4, Investigação de caso de estudo 5.

**Research Directory****Short Haul Rail Freight Services**Marin Marinov 1<sup>\*\*</sup>Philip Mortimer 2<sup>††</sup>Tom Zunder 3<sup>‡‡</sup>Dewan MZ Islam<sup>¬¬</sup>**Abstract**

This paper aims to demonstrate that short haul rail freight services could be tenable and would present market opportunities which conventional wisdom has dismissed. A desk top analysis and case study research unveiling the current situation in the UK have been conducted that concluded that there could be benefits to rail freight companies and train operators/owners if they provide short distance rail freight services for regular operations, short notice and spot traffic categories. The paper also touches briefly upon existing classes of models for supporting managerial decisions for rail freight questioning the fact that up-to-date models

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and methods are required to help railway freight operators improve their operational efficiency. At the end the paper draws conclusions and identifies avenues for further research.

**Key words:** Rail freight 1; Short haul 2; Models 3; Desk top analysis 4; Case study research 5.

## **1. Introduction**

Rail's ability to move large quantities of freight over long distances has never been in question. It is a commonly held opinion that rail can only be economically competitive over longer distances. The term "longer distance" varies substantially from country to country and from continent to continent. In the UK the "longer distance" appears to be set at 130 - 150 miles for block-trains. Many have stated that this is the lowest bound where rail freight possesses business advantages, which immediately limits rail's potential competitiveness and market share penetration for shorter distance and intermittent flows.

In term of freight transport, important factor to consider is type of commodity. It has been shown that in Canadian markets for the relatively high-value commodities, short-haul traffic is largely dominated by the truck mode, and significant rail-truck competition exists only in the medium and long-haul markets. For the relatively low-value commodities, effective rail-truck competition exists only in the short-haul markets. Hence, the medium and long-haul markets are largely rail-dominated (Oum 1979).

The common view that short haul freight transport markets are largely dominated by the truck mode may have questionable roots. Whilst there have been a number of initiatives in Europe promoting high-value low density goods by rail in the short-haul markets, the rail-dominance in the medium and long haul markets for the relatively low-value commodities has decreased significantly.

What defines the distance at which a rail freight service is economically viable, or in other words the breakeven point, is a mix of technical, operational, commercial and managerial inputs. Currently, the prevailing block-train model operating on a point to point basis reflects the preferred position adopted by the main UK rail freight operators. What is observed is that many other railway administrations around the world still retain short haul rail freight operations for a wide range of traffic and commodity flows as an integral part of the wider freight service offer.

This paper sets out to demonstrate that rail could compete over shorter distances but this may require a wholly new approach to asset management, planning, technology and resource allocation to make rail more competitive.

A key factor preventing many companies of using rail freight is the lack of suitable terminals (inter-modal and rail only) close enough to the company's premises. In that case a road transit is needed for final delivery or pick up. Transshipment operations are thought of as one of the main causes of delay and cost and therefore many clients avoid multi-modal services as a consequence. Being able to minimise or remove road transport involvement is one option with rail collecting or delivering cargo as close to the point of origin or destination as practically possible.

The central theme of this paper is: Could rail freight secure real and demonstrable commercial, economic, environmental and social benefits over short distance route sectors and what would be required to make that achievable and sustainable on merit?, and is organized as follows: a discussion on short haul rail freight systems is provided in Section 2. Section 3 touches briefly upon classes of models for rail freight tactical planning. A description of regular short haul rail freight services between Grangemouth and Elderslie (Paisley) to the West of Glasgow is presented in Section 4. Section 5 summarizes the main conclusions of the analysis followed by Section 6 outlining avenues for further research.

## **2. Short Haul Rail Freight Systems**

This paper looks at shorter distance transits; not at shorter trains. In this section we provide a discussion on short haul rail freight systems.

It is true that a few decades ago there were coal traffic operations of less than 30 miles for traffic from pits to power stations in the UK rail that demonstrated that rail freight can compete siding to siding over short distances if the train productivity and management is tight and disciplined. Simply the key for the short haul rail freight services is to basically get the train from the load point to the discharge point (factory/warehouse) with no intermediate marshalling and with all the loading costs and activity undertaken by the shipper/consignee.

Fully loaded high cube freight cars (US dimensions over 85 feet long) can easily outperform a road truck on volume by a factor of 3 - 4. We feel that this advantage has not been exploited by the rail freight operators. On the other hand it is worth noting that pallet/stillage loading

and stripping to ensure high vehicle productivity could make rail freight a competitive option where full car load traffic on a point to point basis can be serviced.

Short trains could work well over short distances. Short trains could also work well over longer hauls if the economics and technology can be made attractive, cost effective and profitable. It is our connotation that this is where many rail freight operators fail. Calculations suggest rail freight can compete with road at  $< 100$  miles even on inter-modal and this suddenly makes a lot of road traffic rail competitive. Shorter trains are not a subject for discussion in this paper and therefore we shall not discuss this issue further. Instead the interested reader is advised to consult Robinson and Mortimer (2004a, b).

Recalling short haul rail freight services, there are examples in Scotland to quote that show that there can be real benefits to companies and customers using short distance services for regular operations. One of them is the 43 mile movement of intermodal and containers bodies from Grangemouth across Central Glasgow to Paisley, which we present in Section 4 of this paper.

Others examples of short haul rail freight systems in the UK are those of pit to power station coal traffic (Selby to Drax) where the movement was about 15 miles in each direction and previous container trains from Southampton and Felixstowe to London. Unfortunately, both have been lost as the terminals were closed and redeveloped for other uses, meaning all of this traffic now goes by road. This situation confirmed that the fundamental economics of big trains with expensive locomotives means that short distance traffic is ruled out unless there are intensive point to point options. UK rail freight operators seem to have been very slow in finding these applications, hiding behind the allegation that the cost base is too high and the productivity is too low plus the freight trains take too long to plan and route with any measure of flexibility.

If the economic “combat radius” of trains can be successfully brought down to  $< 100$  miles then that opens up markets but requires a new approach that utilizes equipment and resources in a wholly different manner to constrain the cost base and maximize the utilization of traction and rolling stock. We feel it needs a huge step change in intensity of asset utilization with rapid load and discharge and very intensive asset management and planning. The key competition to rail is universally available and cost competitive road transport. For rail freight



to succeed needs not only a recasting of the operational, technical and commercial model but also a massive increase in productivity, availability and responsiveness to market requirements.

Rail's response to short haul freight opportunities could be in the form of closed loop operations serving a specific shipper or commodity (coal/aggregates/containers) or as open services where freight train space is made available to shippers on scheduled or spot services. The latter implies the freight train operators assuming some of the commercial risk to underwrite such services. Existing long haul container operations are largely underwritten by the shipping lines with the train operating companies effectively wholesaling their services with the provision of traction and rolling stock. There is a high level of commercial risk aversion within the sector that also adds to the constrained competitive stance of rail within the total freight market. Short haul rail freight prospect is limited under its current strategic positioning. The rail freight industry appears to want copper plated fireproof back to back contracts and levels of traffic that fit the present preferred "orthodox" model of operations, which could be a real constraint on breaking into markets and retaining its position on merit including short haul initiatives.

The dismal performance of rail freight marketing and the obsession with block trains both have distorted the perception of rail's fundamentally competitive positioning (SEStran 2010, pp 34-43). For bulk flows the obvious limitation is the empty back haul. This applies to most bulk flows and empty re-positioning of stock, which is a genuine transport service input that is often overlooked and kept unutilized.

For inter-modal traffic past examples of services from ports to inland terminals at distances of under 100 miles are examples of where rail's internal focus and orthodoxy led to the abandonment of such services for a focus on long haul rail freight business. Arguably, this was part of a wider, but ill advised, policy position to move away from serving large cities (London is a particular and acute example) leading to the loss of terminal locations and future participation in short haul traffic. Balanced flows of containers from ports to inland terminals are not always achieved using larger train sets due to complexities and vagaries in areas such as port handling, ship arrival and departure patterns, container restitution rules and terminal capacity and performance capability.

Other examples of short haul traffic include the movement of car parts from Swindon to Longbridge (Birmingham) using specially designed rail vans for rapid loading and discharge. Wagon load or carload traffic moving short distances remains part of rail's commercial arsenal in other rail domains but has almost wholly vanished from the UK scene in response to stifling commercial, operational, technical and financial rigidity and a genuine lack of flair and competitiveness.

For rail to re-enter short haul freight markets there is a need to match not only the commercial capability of the competition (response time, service times, cost effectiveness, profitability for owners, operators and users, etc.) but also in terms of appropriate products and services which rail can deliver against these criteria. This may imply significant changes in the freight vehicle configuration, size, loading and discharge options including bulk and palletized traffic and also means of reducing the cost of traction. Existing large locomotives, for instance Class 66, are expensive assets and may not lend themselves economically, commercially and operationally to short haul freight services.

For rail to compete over shorter distances it requires both the ability to operate freight trains on a complex and heavily trafficked networks and a service to be available at the times the shippers/receivers dictate. There are options to go for a scheduled pattern of operations. A more adventurous option to move, which is required in response to traffic and cargo offers, opens questions about dynamic scheduling and the ability to offer routes, schedules and timings together with resource allocations that present methods seem unable to respond to with anything like that of the competition. This also suggests the need to be able to move on the rail network at speeds that do not conflict with other services. Rail freight cannot succeed if it imposes delays on following trains or consume excessive numbers of train paths because of the constraints of the present technology, low power to weight ratio and excessive acceleration and braking times.

Network capacity is often mentioned as being a constraint that precludes the acceptance of more freight onto the system. On certain key trunk routes this may apply but it is our contention that large parts of the UK rail network, as in many other rail networks, are not capacity constrained and could accommodate additional services. Again a rigidity of focus has often sterilized the availability of train paths and a false reinforcement that the system is on the verge of collapse through excessive use. The need for maintenance of track and

infrastructure is obviously vital and needs to be factored in but the priorities need to be reviewed to ensure the maintenance tail is not wagging the commercial railway dog. The non-availability of key lines serving UK ports allegedly for maintenance effectively precludes rail from a 7-day position to run trains.

A real constraint on the development of new short haul rail freight services is the absence of load and discharge points to serve shippers and receivers. Many sidings and industrial spurs were removed under “rationalization” schemes in the past. The introduction of complex and expensive signalling, communications and electrical power supplies for traction has made the option of construction of new sidings difficult if not impossible to restore or insert into complex track situations. The cost of new connections makes the commercial case for rail less tenable if such links are a pre-requisite to service new short haul freight flows. The possibility of developing some form of flexible kit including lines and signalling to facilitate the rapid resurrection of lines and connections previously declared redundant may be a useful research option.

The re-activation of rail facilities for active short haul freight operations could raise problems from surrounding land uses. This has in the past been the cause of schemes to fail or be abandoned. Issues of noise and traffic generation for deliveries or collections from rail heads by road vehicles have been the primary objection. This point needs serious consideration in any new project and research proposals to take account of train movements and cargo handling, hours of operation and mitigation measures that could be reasonably implemented to minimize noise and other externalities.

On a more positive note there remain, in the UK, many sidings and spurs that are primarily used for railway infrastructure support and other functions could be modified for use as short haul load/discharge points. The position in Europe and North America is much more robust in that many more sidings and spurs for access to industrial sites are still in situ and have not been closed as part of so called “*economy measures*”. Once lost this sort of facility is costly to reinstall and reactivate.

Short distance train operations need to recognize the requirement to maximize asset utilization. Locomotives in particular are expensive assets that need to be in revenue earning service to pay their way (leased or owned they have to be remunerated). Large numbers of

locomotives appear to spend a lot of time not moving trains. Dwell times at container terminals of over four hours are not uncommon. For inter-modal traffic the requirement to load and remove containers in a much reduced time frame is essential. This could use existing heavy weight equipment or possibly trailer mounted cranes to service the freight trains without recourse to an expensive capital outlay. Simple austere terminals with tightly defined active areas for load/unload activities could drive up both terminal productivity and that of the traction and rolling stock and reduce the costs of operation. This suggests a much more intensive focus on asset management, planning, monitoring and responsiveness to disruption.

For palletized traffic the ability to load and strip vehicles rapidly is of equal importance, particularly if the cargo is governed by high value and time sensitive imperatives. This may dictate the use of fixed or mobile cargo handling equipment to ensure the overall productivity of the rolling stock is secured by the minimization of the time allocated to loading processes.

For short haul applications rail operators should not be providing low cost storage for shippers but should be looking to maximize the earning capabilities of their assets. To maintain high productivity also suggests the need to have real time knowledge and control of the assets, their technical and commercial status and a clear intent on the planned use of them. Shippers need to know the location and status of their cargo and of any disruptions to planned movements. Updates on revised estimated times of arrival in response to service disruption are a vital requirement.

### **3. Classes of Models for Rail Freight Tactical Planning**

It has been a long tradition to use models in aiding decision-making processes in railways. It is our contention that the current state of the art lacks to offer suitable models and methods for analysing railway freight performances due to the fact that it follows the orthodox concept (Marinov et. al. 2010).

For rail freight tactical management, the existing classes of models are categorized as follows:

- 1<sup>st</sup> class: Service Network Design – this is to identify the transport flows, the quantities and types of freight for transportation, the origins and destinations of demand as well as the possible (existing) routes over the network. Recent

contributions focusing on intermodal service network design are provided by Crainic (2000, 2002), Pazour et. al. (2010).

- 2<sup>nd</sup> class: Empty Balancing/Run - this is to specify the general tactical scheme for satisfying the clients' demand with empty freight wagons and contributions to this class of models have been provided by Joborn et al. (2004), Razmov (2004) and Marinov (2006).
- 3<sup>rd</sup> class: Traffic Distribution – this is to specify the movement of empty and loaded freight wagons within and between delineated geographical areas (Razmov 2003).
- 4<sup>th</sup> class: Yard Policies – this is to specify the yard processing capabilities and yard workloads (Marinov and Viegas 2009a,b).
- 5<sup>th</sup> class: Line Policies – this is to specify the capacity of railway lines and the movement of freight trains over time. Many have contributed to this class of models. We shall mention only a select few as follows: Moreira et al. (2004), Pachl and White (2004), White (2007), and Kontaxi and Ricci (2009).
- 6<sup>th</sup> class: Network-wide Policies - this is to specify the organization of the freight train movement according to yard policies and line policies (Lu et al. 2004, White 2005, Marinov and Viegas 2010).

If rail freight is to break back into markets by employing new concepts and providing new services, one of which is short haul freight by rail, the sector has to rapidly adapt to changing political measures, economic trends and market conditions. It is therefore a field where reliable models and methods are required to help railway freight operators improve their operational efficiency and rationalize their tactical planning decisions.

The existing classes of models, as presented above, need to be updated to adequately address the current situation because their role in supporting managerial decisions for railway freight services now assumes renewed importance.

#### **4. Case Study: Regular Service between Grangemouth and Elderslie (Paisley) to the West of Glasgow**

In August, 2009 Direct Rail Services Limited (DRS) together with W.H. Malcolm Ltd launched a rail freight service that is approximately 70 km in length in the Scottish region between Elderslie and Grangemouth.

Direct Rail Services Limited (DRS) is a national (UK) rail freight company. W.H. Malcolm Ltd is a leading Scottish provider of logistics and construction services.

The traffic of containerised products was planned to run five days a week. It was thought that there is potential for this service to increase to 6 days a week at a later stage. A daily train was aimed at hauling 25 shipping containers of 20 and 40 in sizes.

As a whole the service is thought of as a sustainable alternative to the congested A80 and is expected to demonstrate ability to provide cost effective solutions over relatively short distances.

According to the official website of Direct Rail Services Limited (DRS) (<http://www.directrailservices.com>, consulted on January, 9, 2011), it was estimated that a CO2 savings of 3000 tonnes per year will be experienced, which equates the removal of 12 500 lorry journeys off the road between the West of Glasgow and Forth Ports at Grangemouth.

For the purposes of this discussion desk top analysis and case study research including interviews with W.H. Malcolm staff have been conducted. Data has been collected that described the current situation, as follows:

<b><u>No</u></b>	<b><u>Query</u></b>	<b><u>Response</u></b>
<b><u>1st Category: Trains</u></b>		
1.	Total Number of freight trains per day from Grangemouth to Elderslie	<i>Average 3 per week at present</i>
2.	Number of freight wagons per train from	<i>12 x Megafret twin platform</i>

	Grangemouth to Elderslie on average	<i>wagons</i>
3.	Payload Weight from Grangemouth to Elderslie on average	<i>440 m</i>
4.	Weight of train from Grangemouth to Elderslie on average	<i>Payload weight 680t eastbound and 120t westbound</i>
5.	Length of train from Elderslie to Grangemouth on average	<i>440 m</i>
6.	Payload Weight from Elderslie to Grangemouth on average	<i>Payload weight 680t eastbound and 120t westbound</i>
7.	Total Number of freight trains per day from Elderslie to Grangemouth	<i>There are none others than Malcolm's</i>
8.	Number of freight wagons in train from Elderslie to Grangemouth on average	<i>12 x Megafret twin platform wagons</i>
<b><u>2nd Category: Time</u></b>		
1.	Total Travel Time from Grangemouth to Elderslie on average	<i>2.20 hours</i>
2.	Departure Time from Grangemouth	<i>At 06.00</i>
3.	Arrival Time at Elderslie	<i>At 08.20</i>
4.	Total Travel Time from Elderslie to Grangemouth on average	<i>2 hours</i>
5.	Departure Time from Elderslie	<i>At 10.20</i>
6.	Arrival Time at Grangemouth	<i>At 12.20</i>
7.	Intermediate Stops	<i>None</i>
<b><u>3rd Category: Terminals</u></b>		
1.	Total time in Grangemouth per freight train on average	
	a. = waiting time + time for inspection + shunting time + time for loading + waiting time before departure	<i>NA</i>

	b. Number of lines in the terminal (layout)	<i>3 lines</i>
	c. Personnel: <ul style="list-style-type: none"> <li>• Inspection</li> <li>• Shunting</li> <li>• Loading and Unloading</li> </ul>	<i>3 people per shift (Carried out by Direct Rail Services)</i>
2.	Total time Elderslie in per freight train on average	
	a. = waiting time + time for inspection + shunting time + time for unloading + waiting time before departure	<i>2 hours</i>
	b. Number of lines in the terminal (layout)	<i>2 lines</i>
	c. Personnel: <ul style="list-style-type: none"> <li>• Inspection</li> <li>• Shunting</li> <li>• Loading and Unloading</li> </ul>	<i>Inspection and shunting carried out by WHM staff. There are three people in the depot for all train loading and shunting activities. They also carry out other work.</i>
<b><u>4th Category: Rail Line</u></b>		
1	Is the line entirely single?	<i>No</i>
2	Is the line entirely double?	<i>Yes</i>
3	Is the line entirely electrified?	<i>No</i>
4	Is it entirely non-electrified?	<i>Yes, Diesel traction is used</i>
5	Number of Stations/intermediate stops, if any	<i>None</i>

In addition to the queries made we have included another category of questions, as follows:

**5th Category: Road** (characteristics of the road-leg alternative between “Grangemouth - Elderslie”)

1. Length of the route in km;
2. Total Travel time from “Grangemouth to Elderslie” by truck on average;
3. Total Travel time from “Elderslie to Grangemouth” by truck on average;
4. Time Periods through the day when the route is congested;



5. Congested sections of the route;

6. Incurred delay on average because of congestions.

Unfortunately, this category has not received a significant interest from the approached audience of stakeholders, which hampered the progress of this research, changed its direction and also restricted the scope of the obtained results.

The interest was mainly focused on the affirmation that short haul rail freight services with containerised products can be cost effective for just a single container and therefore there are real benefits to rail freight companies and customers alike. We did not aim to question this affirmation. We aimed to analyse the level of utilization of resources subject to current practice and technical constraints.

Based on the data collected, which is inconsistent in terms of technical detail, our analysis would suggest that the existing capacities are not utilized properly. Three freight trains a week sounds rather odd suggesting the business model may need a revision.

The number of freight wagons per train and train length appear to be in conjunction with the European standards. Many rail networks in Europe do not allow trains longer than 500 m. On the other hand it may suggest that the technical condition of the line is rather poor. The line is not electrified, meaning there are no restrictions imposed by the catenary. In that case it might be of interest to research the possibility of running double-stack container trains.

Currently, the freight trains do 70 km for 2 hours, meaning the commercial speed of the service is 35 km per hour, which is quite low, considering that there are no intermediate stops and that the trains function as block trains.

In terms of payload weight the trains are not utilized properly. The payload of westbound train set is 120t on average. It suggests it might be worth researching alternative configurations of the service, which could lead to a better utilization of resources.

Terminal operations seem to demonstrate a good level of performance. The total throughput time for Elderslie (Paisley) is 2 hours per train. The terminal is managed by Malcolm's staff. It was made known to us that the target service time per truck in the terminals managed by

Malcolm's is 20 min on average. It suggests it is worth studying Malcolm's rail-road terminal operations in greater detail because we feel that there are good practices to learn from.

## **5. Conclusions**

This paper aimed to show that short haul rail freight services could be tenable and would present new market opportunities for rail freight companies and customers alike. A desk top analysis and interviews with W. H. Malcolm staff and other stakeholders have been conducted that suggested that short haul rail freight services with containerised products might be cost-effective for just a single container but this may require a wholly new approach to asset management, planning, technology and resource allocation.

Motivated by this situation we intended to learn from a real world case. We have studied "Regular Service between Grangemouth and Elderslie (Paisley) to the West of Glasgow". Although poor in terms of data we were able to gain a feeling about the production scheme in operation and the level of utilisation of resources. Our analysis suggests that the existing capacities are utilized improperly and therefore it might be worth researching alternative configurations of the service, which could lead to a better utilization of resources and value for money.

A natural continuation of this research work is to develop a simulation modelling methodology for analysing short haul rail freight services. Event-based simulation computer packages such as ARENA and SIMUL8 can be used to implement the simulation modelling methodology developed.

For simulation modelling purposes the short haul rail freight system under study can be divided into its components such as rail lines, interlocking, terminals, stations, and junctions. The performance of each component can be analysed separately. However, no component exists in isolation. All the components belong to the same system. They influence each other. In order to capture this phenomenon, the components of the short haul system can be replicated by interconnected queuing sub-systems forming a queueing network. How the components of the system are replicated is of significant importance for the accuracy of the simulation model.

It is our medium-term goal to develop a simulation modelling methodology for analysing regular rail freight services between Grangemouth and Elderslie (Paisley) to the West of Glasgow. We will continue to work closely with W. H. Malcolm staff and other stakeholders to collect the necessary data and to determine the appropriate level of detail to include in the simulation models.

In conclusion short haul rail freight services may present real benefits and new market opportunities for freight companies and customers in other parts of the world (the EU, the US, South America, Asia, Australia). There might be good cases and pilot projects of rail passenger services worth exploring too. Bullet passenger trains could suggest an effective production scheme for freight. On the other hand linking big cities with bullet passenger trains operating as block-trains could lead to real benefits and comfort for the passenger and the railway operators alike. Bullet passenger trains operating on strict fixed schedules between Rio de Janeiro and São Paulo would increase significantly the comfort of the passenger, which will create further business opportunities and boost economic growth in these regions.

## **Acknowledgments**

The authors wish to acknowledge:

- Mr John Holwell of W. H. Malcolm Ltd. for the collaboration.
- Mr Rui Santos of Instituto Superior Tecnico, Technical University of Lisbon, for giving his time to translate the abstract of this paper into Portuguese Language.
- The editor-in-chief and the anonymous reviewers for generously giving their time to review the manuscript of this paper and provide valuable comments and recommendations.

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